

EVALUATION OF THE LIC LORI ICE CLEANER

BY

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OPERATIONS SUPERINTENDENT

ALASKA CLEAN SEAS

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1.0 INTRODUCTION

An invitation to view a demonstration of the LIC Lori Ice Cleaner was extended to potential purchasers of the system by Hyde Products, Inc. of Cleveland Ohio, U.S.A. The demonstration was arranged by Mr. Seppo Korppoo of LORI Oy Lundin Oil Recovery, Inc. AB, of Helsinki, Finland and took place in the Gulf of Bothnia, Estuary of the city of Oulu, Finland on January 29 and 30, 1991. The Lori Ice Cleaner was supplied by the Helsinki Harbor Administration and the 43.0m Finnish-Swedish Ice Class 1A Super ice breaking vessel LETTO was used for logistical support.

The demonstration consisted of two full days of activities carried out in a broken ice channel approximately four miles out in the Gulf of Bothnia off the city of Oulu, Finland.

Through a "shared cost" agreement between Alaska Clean Seas and the Canadian Beaufort Sea Oil Spill Cooperative I was able to attend the demonstration. There were approximately thirty people representing fourteen organizations in attendance (see attachment 1).

The opinions expressed in this report are not necessarily those of the attendees.

2.0 DESCRIPTION OF THE LIC LORI ICE CLEANER

The LIC Lori Ice Cleaner is a self contained brush type skimmer that can be coupled to various type vessels of opportunity to enable them to serve as oil recovery units in broken ice conditions (Figure 1). It is constructed of six marine grade aluminum modules that are bolted together. It is 14.25m long x 6.00m wide x 1.85m tall and contains three ballast tanks for trim and displacement control. The heart of the skimmer is two stages of Lori bristle aggregates. The first stage is especially designed for ice cleaning and the second stage is for the final separation and collection of oil. There is an ice washing water nozzle system mounted on the bow of the skimmer powered by two 2000+ GPM water pumps which draw water through the first stage ice bristles and second stage standard Lori bristles (Figure 2).

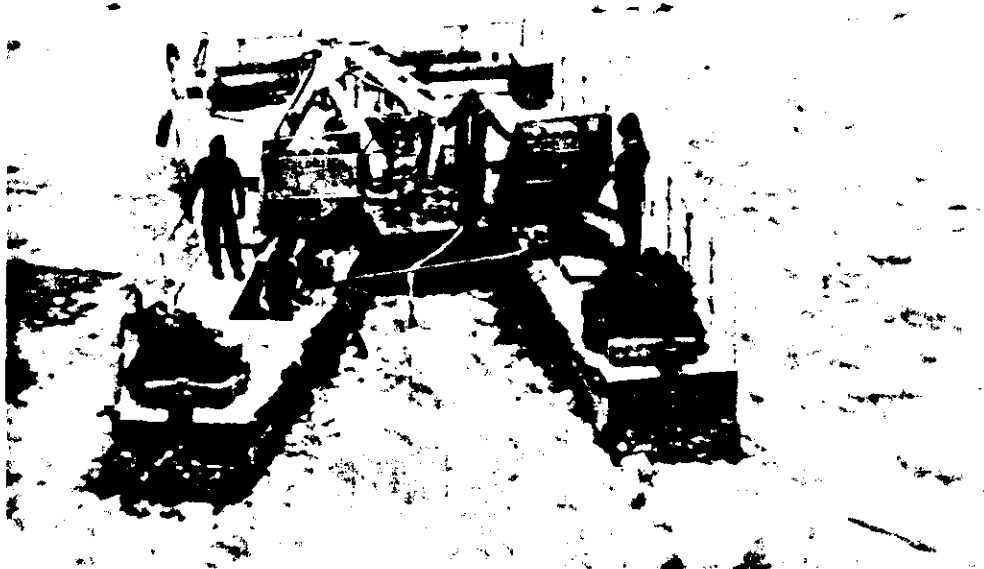


Figure 1 - LIC Lori Ice Cleaner



Figure 2 - LIC Ice Washing System

There are two collection stations on the aft deck and the recovered material can be packed into plastic bags or barrels, or pumped into storage tanks by installing a transfer pump at the collection station. The Lori Ice Cleaner requires electric and hydraulic power from either the support vessel's systems or from a power pack on the support vessel's deck. There is also a hydraulic crane and fire and safety equipment on board. Up to 3 tons can be stored on the LIC deck. The skimmer weighs 20+ tons without the ballast weight installed and it's designed recovery speed is 1-2 knots. See attachment 2 for general technical specifications.

3.0 SUMMARY OF ACTIVITIES

3.1 Day 1

At 9:00 A.M. on the morning of Tuesday, January 29 at the hotel Vaakuna in Oulu, Finland Mr. Seppo Korppoo of LORI gave a short briefing on the schedule of events for the two day testing of the Lori Ice Cleaner and also introduced the captain of the ice breaker LETTO who advised the attendees of the rules aboard his vessel. After the briefing the group was transported by bus to the vessel LETTO and we got our first look at the Lori Ice Cleaner (Figures 3-4). We departed from the dock at 10:00 A.M.. The outside air temperature was approximately -15°C with a light wind blowing and we transitted through 60 cm thick ice to the test site approximately four miles offshore (Figures 5-6). Upon arriving at the test site the vessel LETTO proceeded to break up an area of ice large enough to allow the skimmer to be placed over the side, coupled to the bow and maneuvered over the test spill site. After the ice at the test site was satisfactorily broken up the Lori Ice Cleaner was placed over the starboard side of the LETTO. With the skimmer secured to the vessel, 10 tons of ballast weight, in the form of steel plate and chain, was placed on the stern of the skimmer and secured (Figure 7). The owners had agreed before the tests to use steel plates and chain as ballast instead of water to eliminate any possible problems that might have occurred by using ballast water at below freezing temperatures. Ten tons

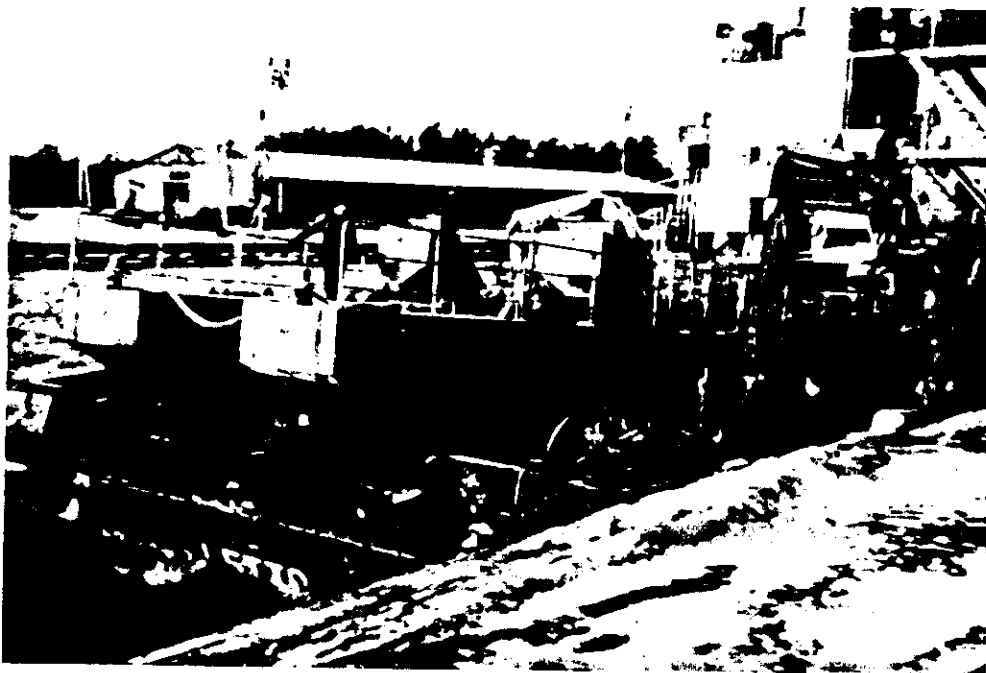


Figure 3 - LIC Deck Loaded On LETTO



Figure 4 - LIC Deck Loaded On LETTO

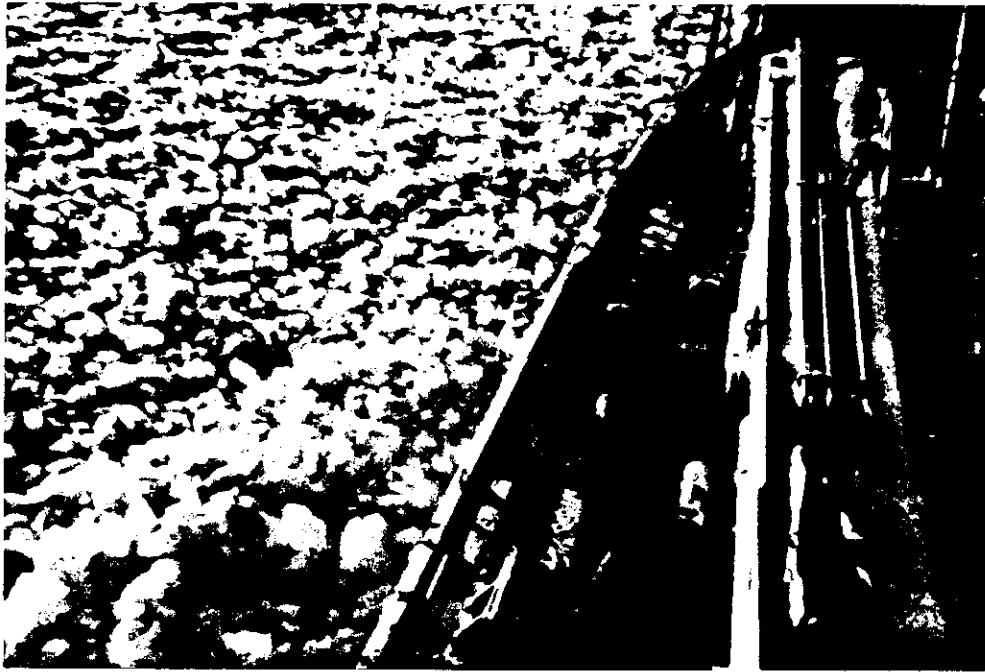


Figure 5 - Vessel LETTO Transitting To Test Site

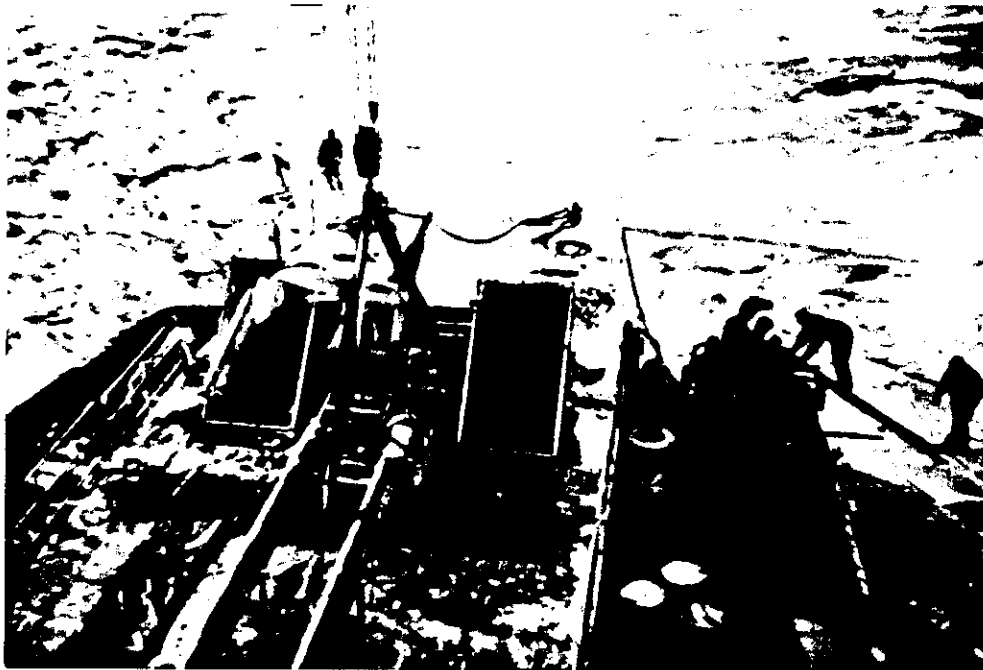


Figure 6 - Vessel LETTO at Test Site

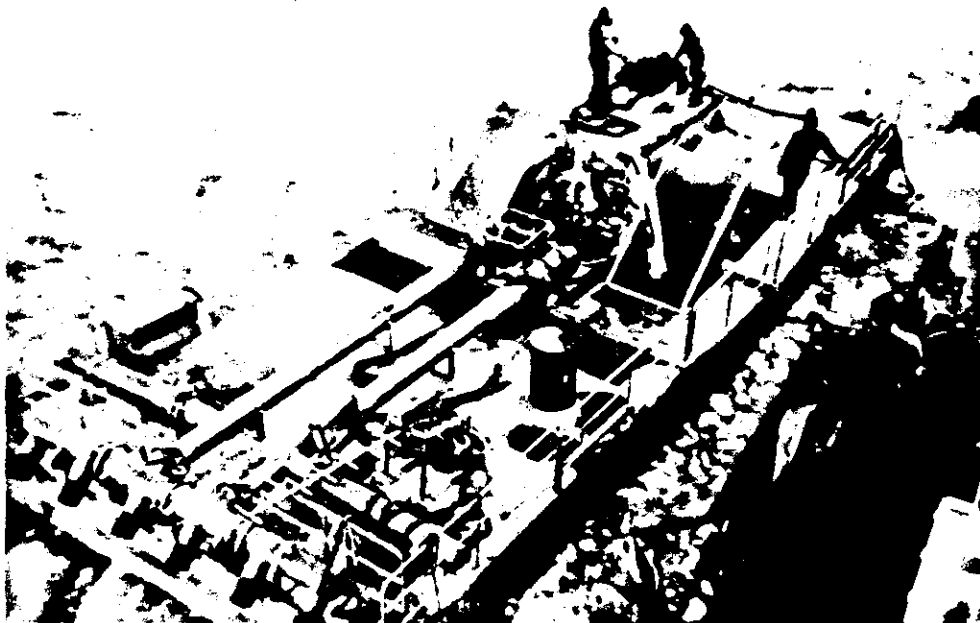


Figure 7 - LIC Taking On Ballast Weight

of ballast weight gave the skimmer the required 6° bow hull angle for proper ice cleaning. Having launched and trimmed the Lori Ice Cleaner the vessel LETTO maneuvered into position and the crew coupled the skimmer to the bow of the vessel. The complete deployment, from launching over the starboard side to coupling to the bow, took approximately 45 minutes. Approximately 40 U. S. gallons of Norwegian crude oil were poured into the water over the port side of the LIC. The vessel LETTO with the skimmer attached backed off from the spill area and made ready to skim by activating the skimmer's bow water spray system and the two stages of the LORI brush system. The LETTO then maneuvered the skimmer into position over the spill site numerous times in an attempt to recover the test oil. The skimmer recovered very little of the test oil and the remaining oil was spread over a very large area in the process. With the testing for the day completed the skimmer was decoupled and loaded back aboard the vessel for transport back to Oulu. The retrieval process took approximately 35 minutes. We arrived back at the hotel Vaakuna at 4:45 P.M. and had our debriefing at the hotel sauna at 5:00 P.M..

3.2 Day 2

We departed the dock aboard the ice breaker LETTO at 7:45 A.M. with -15°C, overcast skies, calm wind and light snow. After arriving at the test site the vessel LETTO broke up an area of ice large enough for the days test.

The skimmer was placed over the starboard side of the vessel, fitted with ballast weight, lashed into position on the bow and connected to its power source onboard the LETTO. Again the process took approximately 45 minutes.

At that point in the test a 600 U.S. gallon 50/50 mix of Soviet and Norwegian crude oil was dumped onto the ice in the test area (Figure 8). Having accomplished that the vessel LETTO backed off from the spill area and made ready to skim by activating the skimmer's bow water spray system and the two stages of the LORI brush system. Through a consensus at the

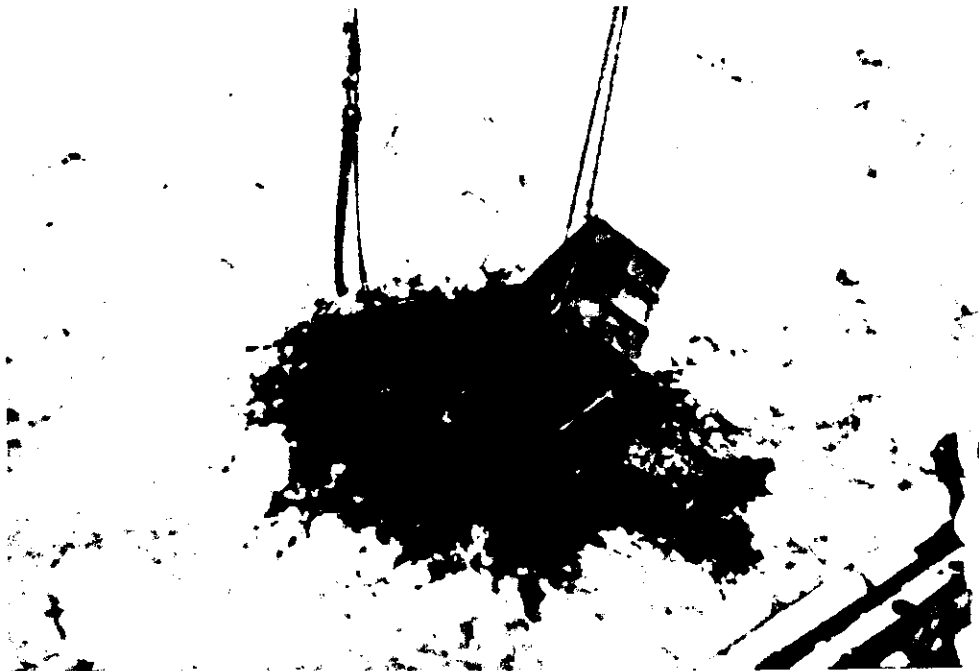


Figure 8 - 600 Gallons Of Test Oil

debriefing the evening before it was agreed that the bow water spray system would be diverted over the side instead of over the bow as it was felt that the water over the bow might be pushing the oil away from the skimmer. The LETTO then maneuvered the skimmer over the test oil spill site numerous times and again was only successful in spreading the oil over a larger area (Figures 9-11).

The skimmer was lifted back onboard the vessel (Figure 12) and we transitted back to Oulu arriving at the hotel at 4:15 P.M. A debriefing by Seppo Korppoo was held at the hotel and concluded at 5:45 P.M..

4.0 EVALUATION OF SKIMMER PERFORMANCE

4.1 Transporting

The LIC is constructed of six marine grade aluminum modules with the largest designed according to the maximum dimensions of a standard 20 ft. container (6.048m x 2.438m x 2.438m). This allows for flexible storage and transportation via land, air or sea. Once the skimmer is bolted together though the package becomes quite large. With an unladen weight of 20+ tons, physical dimensions 14.25m x 6.00m x 1.85m and 10 tons of ballast weight the skimmer requires a very substantial support vessel. If the skimmer is to be used any distance at all from its home base it will have to be towed by the support vessel or it will require a vessel with enough deck space and stability to be able to store the skimmer, its power supply and its ballast on the deck. If carrying the skimmer, the vessel must also have a large enough crane to be able to set it over the side.

4.2 Deploying And Retrieving

The deployment and retrieval phases of the skimmer demonstration went smoothly. 45 minutes for deployment and



Figure 9 - Test Site

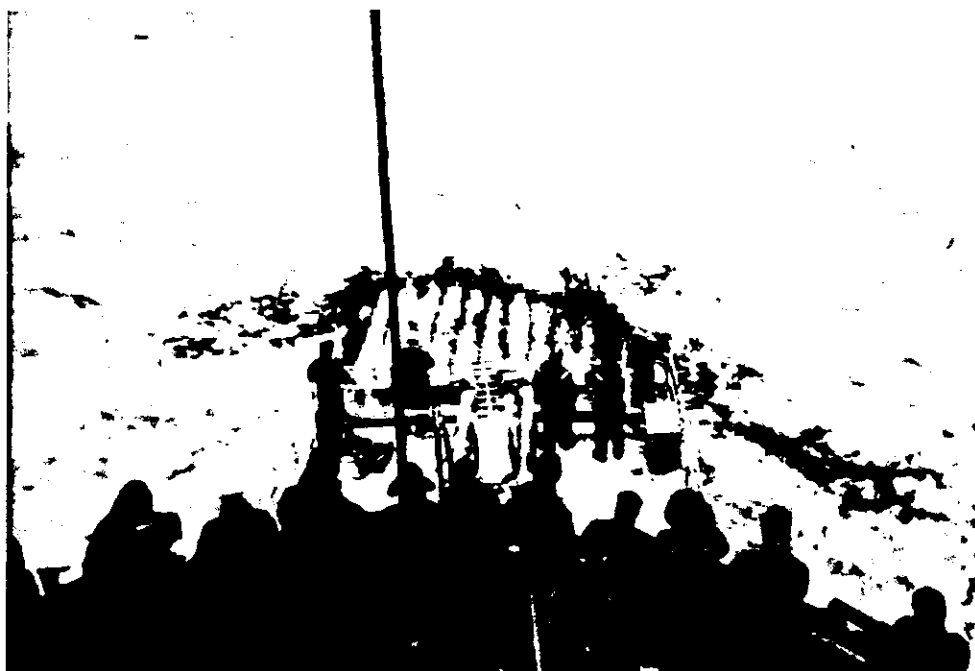


Figure 10 - Test Site

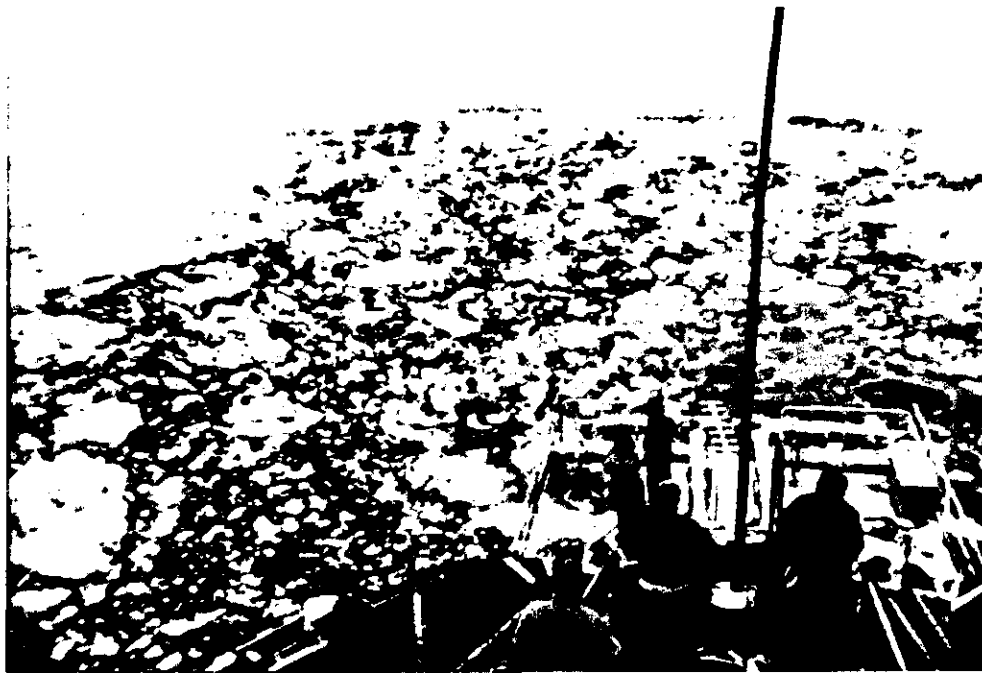


Figure 11 - Test Site

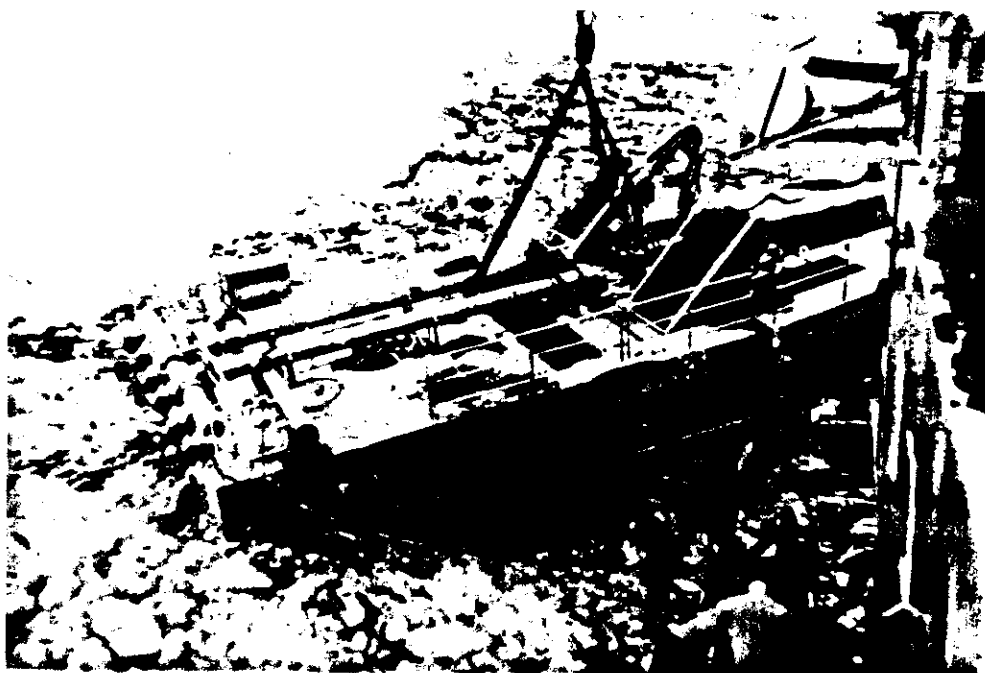


Figure 12 - Loading Skimmer

35 minutes for retrieval are respectable times for a skimming system of that size. The vessel LETTO was a very capable support vessel and the support crew was well trained. The size and capability of the support vessel used in conjunction with the LIC and the experience level of the crew have a very direct influence over the successful deployment and retrieval of the unit.

4.3 Coupling and Decoupling

The LIC is designed to be attached to the bow of the support vessel. After the skimmer is deployed over the side of the vessel a four man crew is placed on board and readies the lashing gear. The support vessel then noses into the space between the two stern modules of the LIC and is coupled to the skimmer by means of a universal type lashing system. The lashing system consists of chains and lines which allow several different bow configurations to be used. This allows for greater flexibility when choosing a support vessel. The recommended vessel is a tug boat which is 20-40 meters long and 5-10 meters wide. The decoupling is simply a reversal of the coupling process.

4.4 Maneuvering

The LIC Lori Ice Cleaning skimming system appeared to be very maneuverable during the two days of tests. The vessel LETTO, with its bow thrusters and controllable propellers is an extremely maneuverable vessel and when coupled with the LIC makes a very good system. The LETTO, with the LIC attached had no trouble transitting, turning or backing down in the test area and I think most of the attendees were impressed with the ice thickness and ice coverage in which the skimmer was able to operate.

4.5 Skimming

The explanation of the two days of testing and the pictures enclosed in the report give a good overview of how successful the skimming operation was. This portion of the exercise had the most glitches during the two days of testing.

The first stage ice cleaning brushes tended to freeze to the skimmer hull after being removed from the water in freezing temperatures and had to be mechanically broken loose and started by wrapping a line around the brush chains and physically tugging on them using the tuggers on the support vessel.

The water wash system on the bow of the skimmer appeared to herd or push the oil away from the front of the LIC thereby cutting down on its encounter rate.

The second stage final separation and collection brushes picked up lots of pieces of ice and deposited them into the collection system at the stern of the skimmer. The oil that ended up in the collection bags was minimal.

5.0 Conclusions And Recommendations

I was sent to the LIC Lori Ice Cleaner demonstration to evaluate the skimmer from an operations persons point of view and was immediately impressed with the ice coverage and thickness in which the skimming system was able to operate. The skimmer operated both days of the testing in 60 cm thick ice and didn't suffer any apparent damage.

I think the decision to use metal ballast weight in place of water ballast while operating in freezing temperatures was a good one and also think some work should be done on redesigning and installing a permanent ballast system using metal or concrete instead of water. The present skimmer configuration would very readily accept a ballast system design change.

As mentioned earlier in the report it was felt by a majority of the attendees that the angle of the bow nozzles on the water flooding system caused the water to be directed in such a manner as to cause the oil to be pushed away from the front of the skimmer thereby restricting the skimmer's encounter rate. The encounter rate could possibly be enhanced by redesigning the nozzle system to direct a water spray from out in front of the skimmer back towards the bow.

The pumping system used in conjunction with the bow water flooding system appeared to be very effective in drawing oil through the first stage cleaning bristles. The attendees witnessed lots of oil being pumped over the sides of the skimmer during the second day of testing after it was agreed that the flooding system's water would be diverted over the sides instead of over the bow.

The collection station of the skimmer is an area that could use some refinement. I observed oil stains on the aft side of the modules and in the water below the collection chutes. The collection bag system seems cumbersome to me and I think that in a production model of the Lori Ice Cleaner sumps and offloading pumps would be desired.

I feel that the inability of the skimmer to pick up much oil on both days tests was more a testing error than a design error. It appears to me that the Lori bristle system is more suited for viscous and heavily emulsified products than the light Norwegian and Russian crudes that were used. I would recommend that additional testing be accomplished using crude with a higher viscosity.

In closing I would like to say that overall I am impressed with the Lori Ice Cleaner concept and would hope that more testing of the system will be done to rectify the problems that were identified in this report. Oil cleanup in broken ice conditions is an area that lacks proven technology and more research should be encouraged.

Attachment 1
List Of Attendees

ICE CLEANER

FULL SCALE TESTS WITH OIL

ATTENDANCE LIST

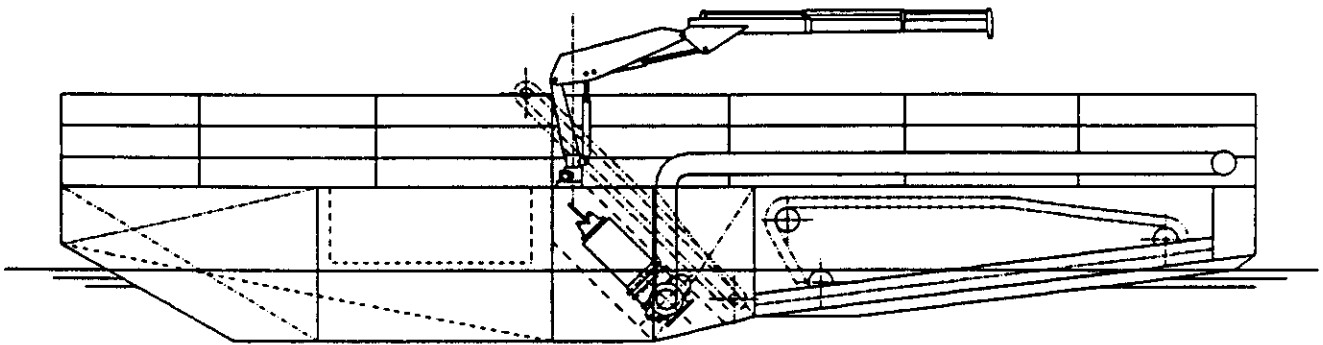
Mr. Seppo Korppoo	Oy LORI Ab
Mr. Lars Lundin	Oy LORI Ab
Mr. Tage Lindfors	Oy LORI Ab
Mr. Bert Hartley	Hartec, Anchorage, Alaska
Mr. Bill Stillings	Cook Inlet Response Organization, Nikiski, AK
Mr. Frank McCorcle	Cook Inlet Response Organization, Nikiski, AK
Mr. Burle Wescott	Cook Inlet Response Organization, Nikiski, AK
Mr. Steve Bowen	Alaska Clean Seas, Anchorage, AK
Mr. Phil Larsen	VECO, Anchorage, AK
Mr. Hugh Brown	Esso Resources, Calgary, Alberta
Mr. John Latour	Canadian Coast Guard
Mr. Todd Mitchell	Navenco, Montreal, Quebec
Mr. Thomas P. Mackey	Hyde Products Inc., Cleveland, Ohio
Mr. Dan Neely	Hyde Products Inc., Hilton Head, South Carolina
Mr. Atle Nordvik	Norsk Oljevernforening For Operatørselskap
Mr. Rick Auger	Norsk Oljevernforening For Operatørselskap
Mr. Widar Skogly	Norsk Oljevernforening For Operatørselskap
Mr. Hans Jensen	Norwegian Hydrotechnical Laboratory, Trondheim
Mr. Jarmo Ratia	National Board of Waters & The Environment
Mr. Kari Lampela	National Board of Waters & The Environment
Mr. Kalervo Jolma	National Board of Waters & The Environment
Mr. Ossi Keranen	National Board of Waters & The Environment
Mrs. Tuula Kuusela	National Board of Waters & The Environment
Mr. Timo Asanti	National Board of Waters & The Environment
Mr. Niilo Kokkonen	Oulu Water & Environment District
Mr. Jorma Ryttonen	State Technical Research Center
Mr. Pentti Vikki	State Technical Research Center
Mr. Taru Vainio	State Technical Research Center
Mr. Seppo Liukkonen	State Technical Research Center
Mr. Lasse Lindroth	Uudenkaupungin Tyovene Oy (Builder of LIC)
Mr. Kari Kaivola	Uudenkaupungin Tyovene Oy (Builder of LIC)

Attachment 2
General Technical Specification

LIC Lori Ice Cleaner

GENERAL TECHNICAL SPECIFICATION

October 1990



Oy Lundin Oil
Recovery Inc. Ab

This document is our property. It is forbidden to reproduce, exploit and show it to a

Patented

The LIC Lori Ice Cleaner
design is protected by several
patents

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LIC Lori Ice Cleaner

GENERAL TECHNICAL SPECIFICATION

1. General description

LIC Lori Ice Cleaner can be fitted in various types and sizes of vessels in order to enable them to serve as oil recovery units in ice conditions. The LIC self contained unit is attached to the bow of a vessel.

LIC is primarily designed to operate in broken ice at sea, lakes, rivers and ports. If the oil spill area is made up of ice thicker than 20 cm or larger than 2 x 2 meter ice floes, the recovery area should be broken up by another vessel before beginning of the recovery operation.

LIC can recover most types of oil and debris in various environmental conditions.

LIC recovery process occurs by a patented two stage bristle aggregate and water pump system.

LIC is designed to be a removable unit attached to the bow of a vessel. The lashing system allows several different vessel bow configurations to be used, allowing flexibility in choosing the pushing vessel. The recommended vessel is a tug boat which is 20-40 meters long and 5-10 meters wide.

A mobile air cooled power module, including a diesel engine, generator, hydraulic pump, fuel tank, hydraulic oil tank, hoses and electric cables, is placed on the deck of the pushing vessel in order to give high autonomy to the LIC unit. The hydraulic power is distributed to the LIC by flexible hydraulic hoses which are attached to the LIC central hydraulic control panel.

Temporary oil storage capacity on board the LIC deck is 3 metric tons.

LIC is provided with IMO specified safety, fire and lighting equipment.

The functions of LIC are shown in APPENDIX 1.

General arrangement of the LIC is shown in APPENDIX 2.

Photographs of LIC prototype are shown in APPENDIX 3.

2. Operation

The oil contaminated ice is prepared for oil removal by spraying water onto the ice from the LIC bow nozzles.

Upon contact the ice is forced below the water surface by the LIC bow, where the buoyancy force and pumping separates the oil from the ice and water.

As the ice is forced down it is cleaned by the first stage Lori ice bristles. High capacity pumps cause a water current through the ice bristles, which increases the efficiency of oil separation.

The oil is gathered through the bow openings in the LIC, where the second stage bristle aggregates lift the oil out of the water, which is practically free of ice at this stage.

The bristle aggregates are cleaned by special Lori cleaners and the oil and debris is transported to the collecting stations by a conveyor system. From the collecting station the oil and debris is transported to storage facilities.

3. Oil recovery capacity and environmental conditions

LIC is designed for the following conditions:

- Recovery speed 1-2 knots
- Air temperature -20 °C
- Water temperature -1 °C
- Ice cover up to 100 %
- Recovery width 5.5 meters, total
- Nominal recovery capacity 100 m³/hour (625 barrels/hour)
(Based on SSPA tests with aged heavy fuel oil)
- Oil to be recovered All grades and ages, including debris
and tar balls.

4. Construction

4.1 Design criteria

LIC is constructed of six unpainted marine grade aluminum modules to allow for flexible storage and transportation via land, air or sea. The modules are bolted together and attached to the pushing vessel by a special lashing system. The largest of the modules is designed according to the maximum dimensions of a standard 20 ft container (6.048 m x 2.438 m x 2.438 m).

LIC contains three ballast tanks for trim and displacement control.

LIC main dimensions:

- total length 14.25 m
- breadth, moulded 6.00 m
- depth to main deck 1.85 m
- operational draft 0.85 m
- displacement 25.10 t

4.2 Bristle aggregates

For separating oil and debris the LIC is fitted with Lori bristle aggregates. The first stage bristle chains are located at the bow. They are especially designed for cleaning ice. The oil, with water, is taken into the hull of the LIC by the bristles and the water pumps. Inside the center collection area there are two standard Lori bristle aggregates, each with six bristle chains, for the final separation and collection of oil.

The bristle chains lift the separated material to the Lori cleaners which clean the bristles by a patented combing action. The speed of the bristle aggregates is adjustable between 0-0.5 meters/second (1.5 feet/second).

4.3 Deck equipment and tanks

The deck equipment consists of a hydraulic crane, fire and safety equipment as required.

For installation the crane is lifted into place on the LIC center module and bolted into place by four M20 bolts. The hydraulic hoses are attached and the crane is tested for operational condition before use.

The fire equipment includes a water/foam extinguisher system and dry powder extinguishers. The water/foam extinguisher is a built-in 200 liter/minute system which uses medium grade foam. This equipment is operated from the bow of the pushing vessel. Hydraulic power is supplied from a separate power module located on the deck of the pushing vessel.

The dry powder extinguishers consist of two portable 50 kg extinguishers which are stored in the LIC during operation.

Safety equipment includes life jackets for a four man crew and one life buoy situated on the deck of the LIC. The periphery of the deck is lined with removable wire railings and the passageway from the pushing vessel to the LIC is provided by two rope ladders. The LIC is built with required navigation lighting. Four hand held radios are included for communications between the LIC and the pushing vessel. Bollards are situated on deck for mooring purposes.

All ballast tanks of the LIC are built with man holes for easy access during the trimming of the LIC by ballast pumping.

5. Water pumps

The water pump system sucks water through the first stage ice bristles and the second stage standard Lori bristles, which arrest the oil before reaching the water pumps. The water is pumped through pipes to the nozzles situated in front of the bow.

The system consists of two submerged water pumps, Scanpump UA 300/300-37 or similar pumps.

The pumps weigh approximately 600 kg and have a capacity of approx. 1000 m³/h at 0.95 bar. The motors are equipped with heat and moisture sensors to prevent overheating and excessive leakage.

6. Collection station

For the reception of the recovered material the aft deck of the LIC is built with two collection stations. Here the recovered material is packed into plastic bags or barrels for storage and transportation. The recovered material can also be pumped to waste storage tanks by installing a transfer pump at the collection station. For temporary storage, up to 3 tons may be placed on the LIC deck.

Each station is manned by one person for the duration of the oil recovery operation.

7. Hydraulic system

The diesel engine powered hydraulic system feeds hydraulic fluid under 200 bar pressure through hoses to the LIC. Pressure valves distribute the hydraulic fluid to the bristle aggregate motors, the crane and the conveyer system. The upper shaft of each bristle aggregate is driven by a hydraulic motor. The speed of the motor can be adjusted according to the recovery conditions in order to minimize the water content.

The speed is adjusted by a regulator valves installed on the deckside controll panel.

8. Electric system

The electric center is located in the diesel power module which is located on the deck of the pushing vessel. For standby heating the LIC is provided with heater blowers. The electricity for the heaters can be taken directly from the pushing vessel in order to make it possible to stop the diesel power module during standby.

Necessary lighting is provided by portable lights.

9. Scope of delivery

The LSC delivery consists of:

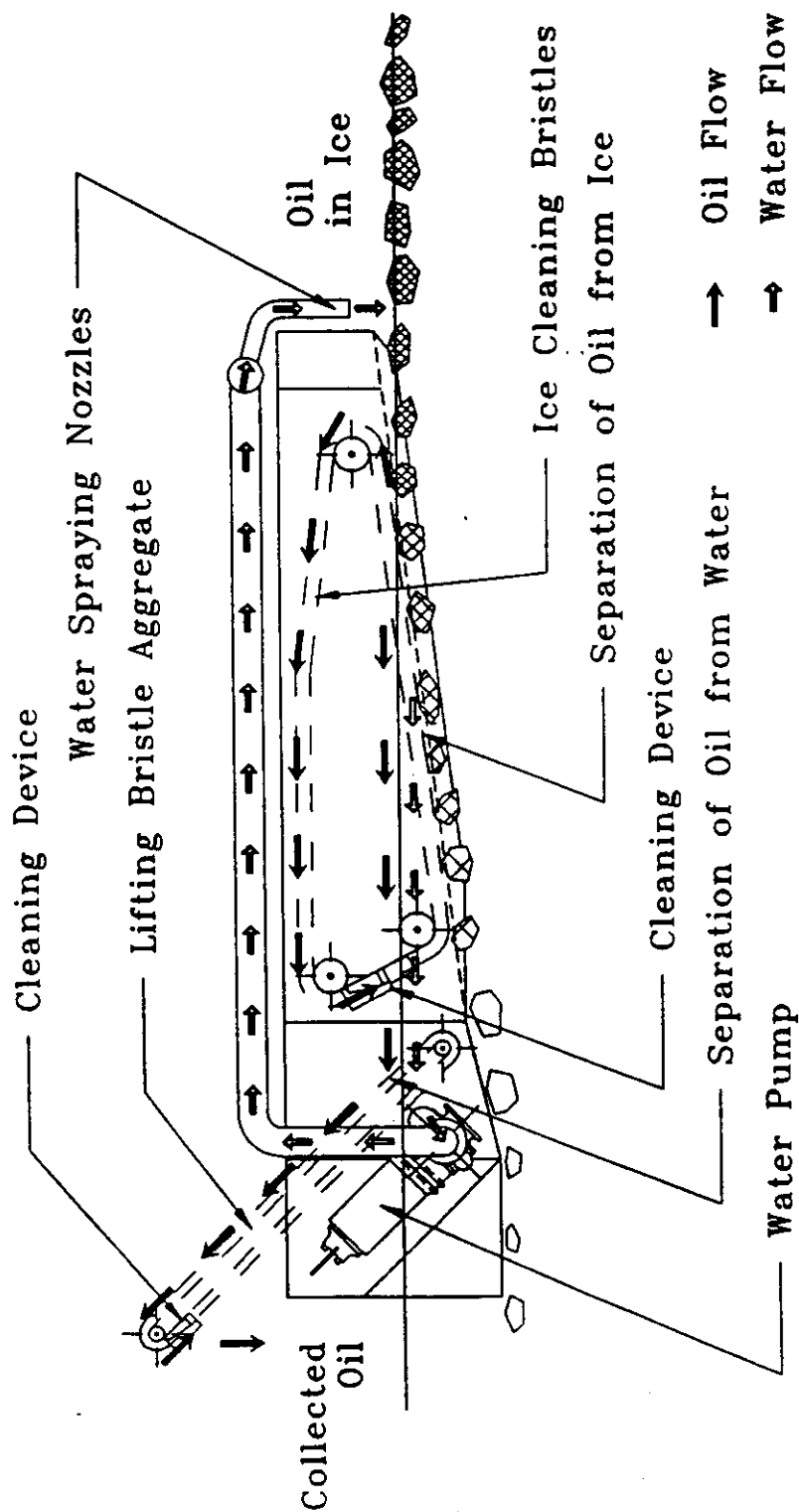
- six modules
- outfitting components
- one power unit
- one storage container
- one set of spare parts
- two sets of delivery documents

10. Inventory and spare parts

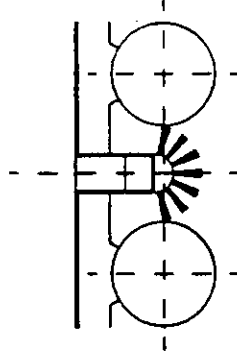
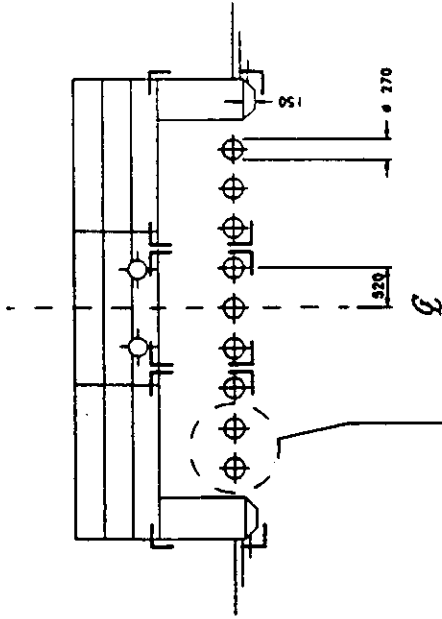
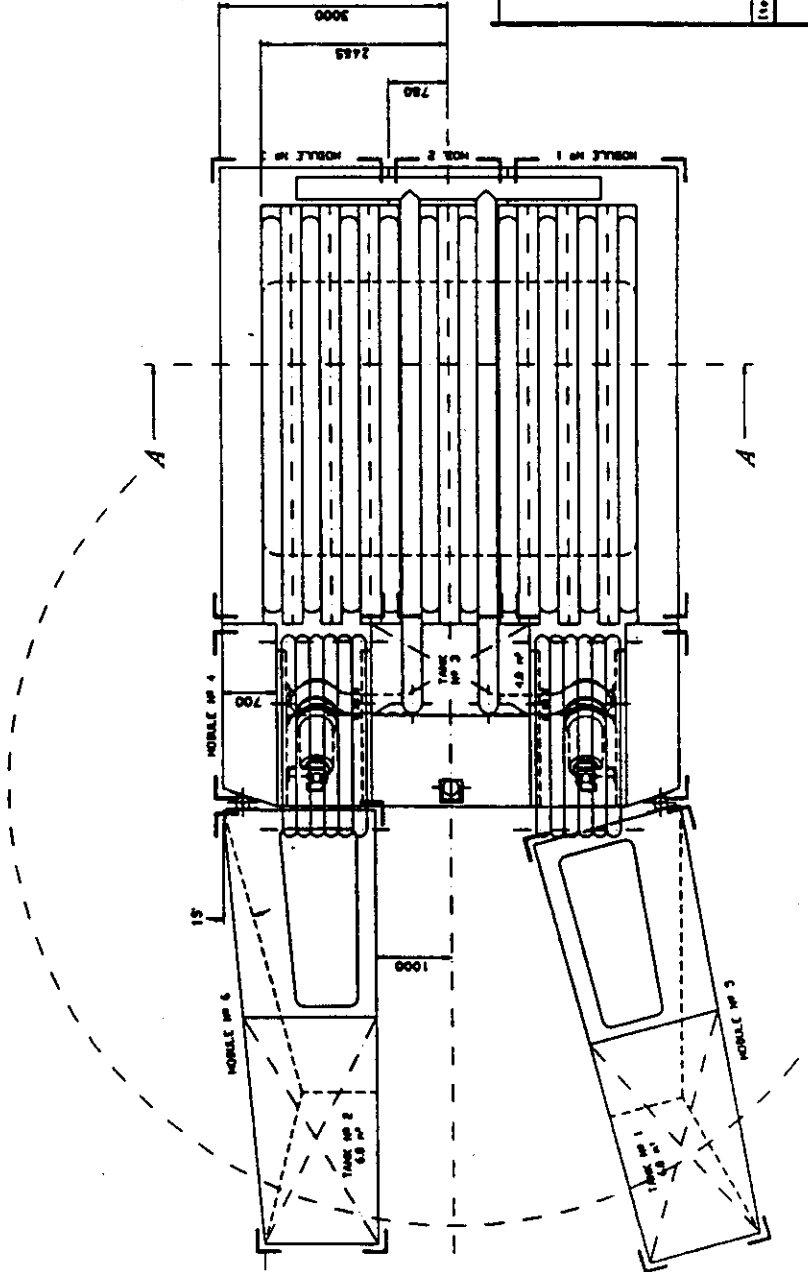
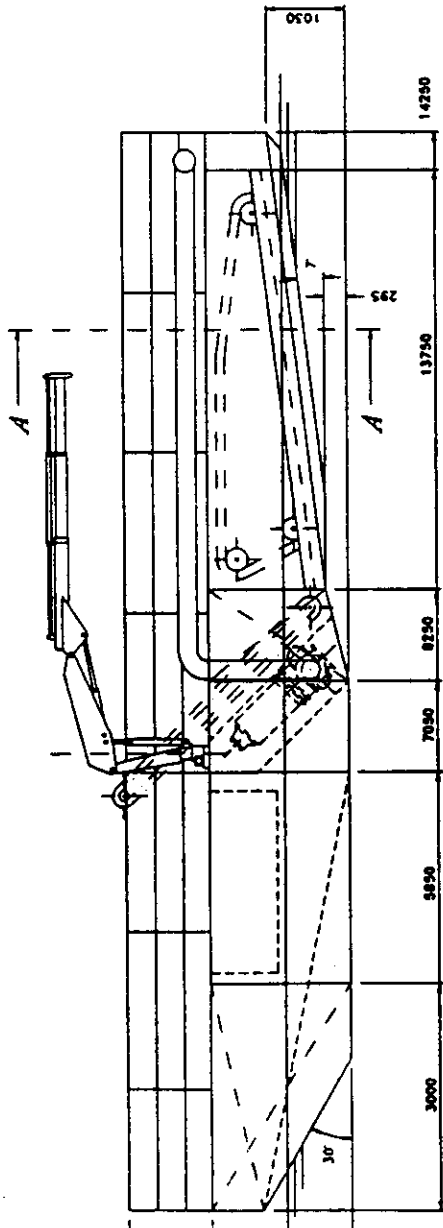
- Item 1 1 ice brush chain
- Item 2 2 meters ice brush chain
- Item 3 1 standard Lori brush chain
- Item 4 2 meters standard brush chain
- Item 5 10 master links of chain
- Item 6 100 ice brush pins
- Item 7 20 ice brush sections
- Item 8 100 standard brush pins
- Item 9 20 standard brush sections
- Item 10 1 set of special tools for the
power supply system
- Item 11 5 module connecting bolts
- Item 12 1 connecting hose of each type
- Item 13 1 filter insert set

Appendix 1

Functions of LIC



Appendix 2



Dimensions:

Length, o.o.

Breath, moulded

Depth to main deck 1.85 m

Operational Drought

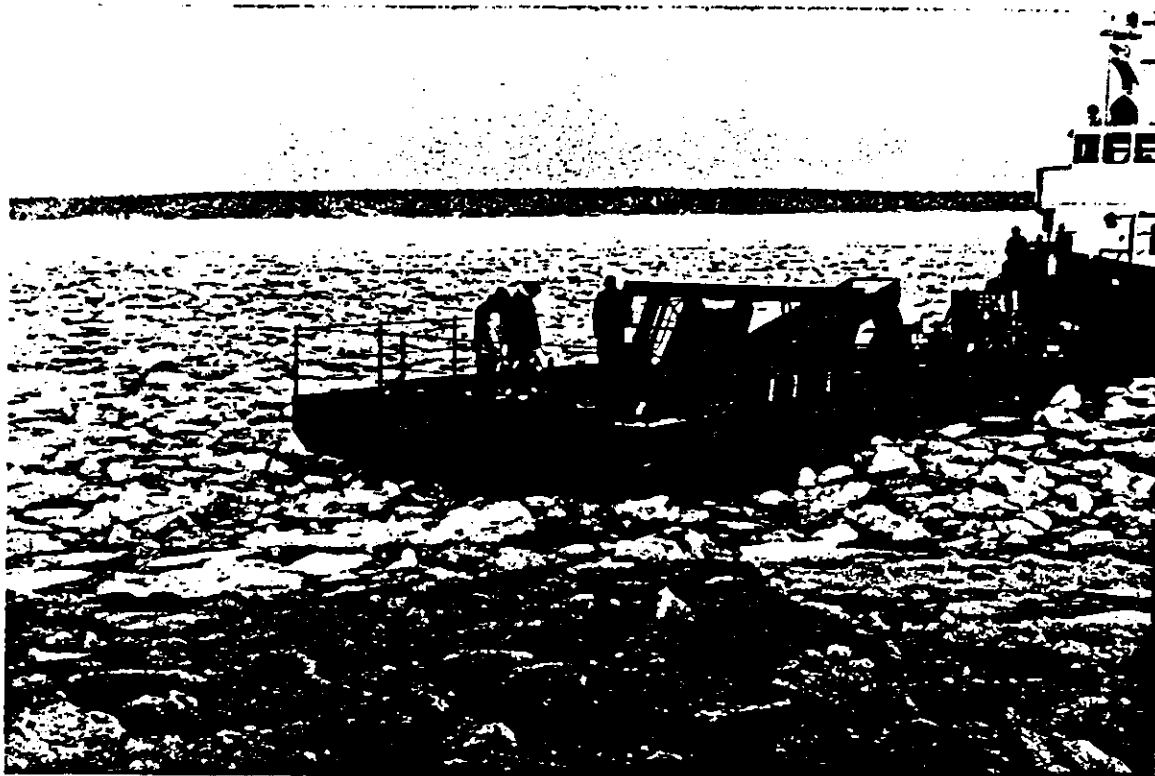
In fresh water **0.85 m**

Displacement obt. 25.10 f

LORE	ice Cleaner	General Arrangement	Scale 1:50	Date 19/3-1980
Drawings Title	Size	Material	Drawing No.	Remarks
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by Ingdon Ooi Borensberg Inc. Sh				

Appendix 3

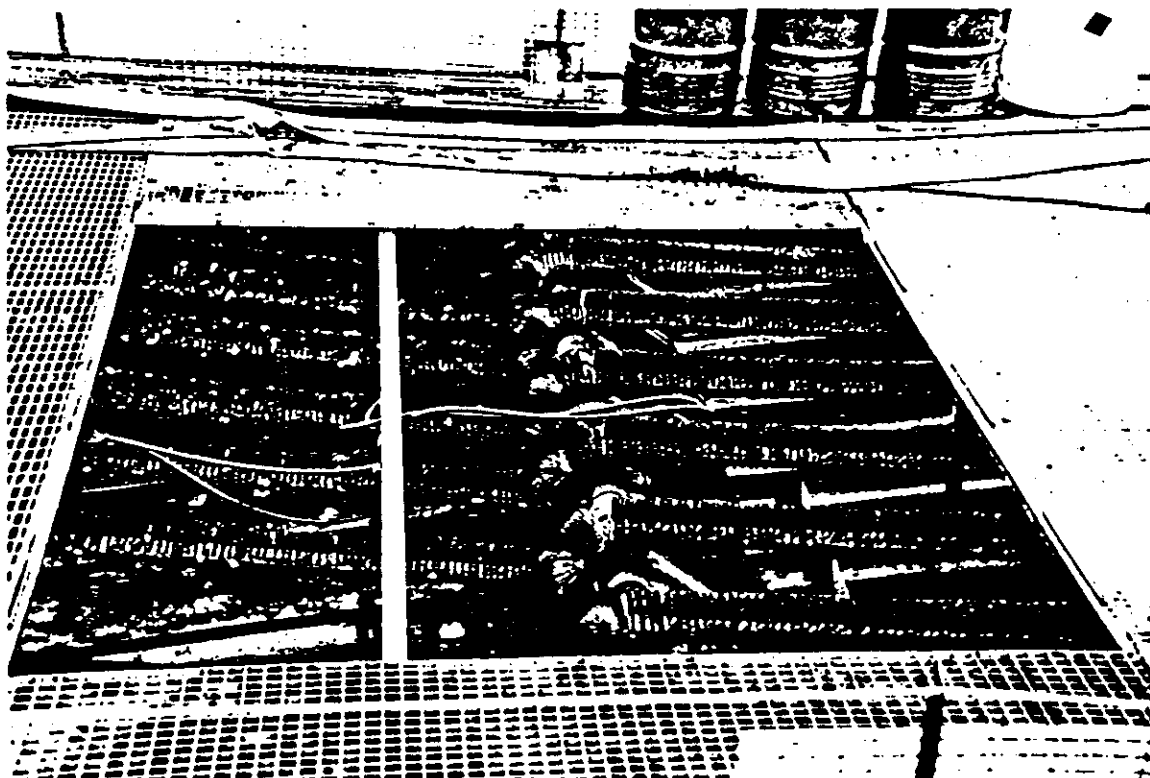
Photographs of LIC prototype



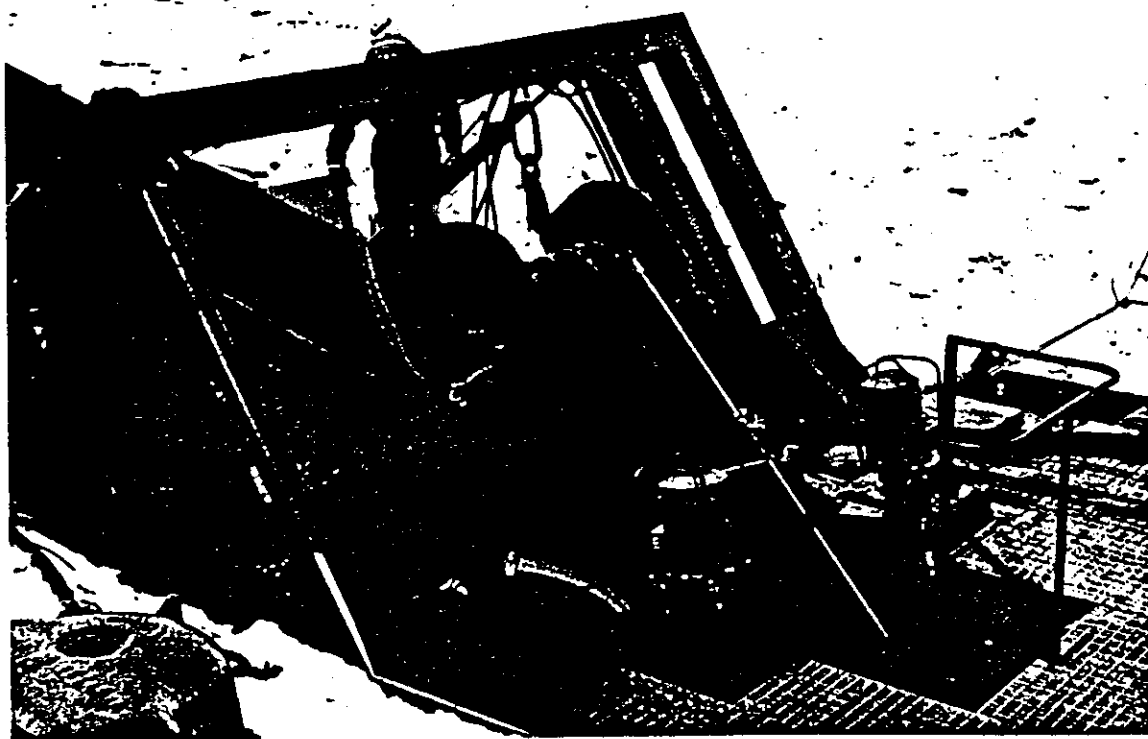
LIC in operation



LIC bow and first stage ice bristles



LIC first stage ice bristles



Stage two standard Lori bristle aggregate